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(54) FIBRE-REINFORCED CEMENTITIOUS ARTICLES

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(57) Claim 1. An asbestos-free article comprising:

(a) from 6% to 12% by weight of cellulose fibres whereof at least a proportion of the individual fibres are uniformly or variously fibrillated to such a degree that the mass of said fibres, as a whole has a freeness value of from 350 Csf to 600 Csf; with,

(b) cement and silica as remainder to 100%, in selected proportions of each to the other.

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FORM 10

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COMPLETE SPECIFICATION

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Complete Specification for the Invention entitled: "FIBRE-REINFORCED CEMENTITIOUS ARTICLES"

The following statement is a full description of this invention, including the best method of performing it known to me/us:—

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This invention relates to articles mainly composed of cement, silica and fibrous reinforcement material. Examples of such articles are: building boards, pipes, roof cladding sheets or tiles, roofing gutters, and moulded articles; and there are others.

Articles according to the invention are particularly akin to those commonly said to be made of "asbestos-cement ("AC") or, more simply, "fibro".

The existing AC articles are largely effective in use; however, they are open to objection in some respects. The asbestos fibre reinforcement material is an expensive item, and the asbestos used in the articles is considered by some to constitute a health hazard, particularly to those engaged in producing it and working with it.

In conventional AC articles it is common to include a proportion of cellulose pulp, in part replacement for asbestos, since cellulose is cheaper than asbestos; the proportion of cellulose being about equal to or a little less than that of the asbestos.

The object of the present invention is to provide articles of the kind indicated, which are similar in appearance to the known AC articles; whereof the strength characteristics (such as impact resistance and flexibility are equal to, if not better than those of AC articles; whereof the modules of rupture strength characteristic is well within the limits of acceptability; which contains no asbestos; is substantially cheaper to produce than is the corresponding AC article; and, uses a proportion of cellulose about the same as, or only marginally greater than,

that now employed in the production of AC articles.

Experiment has shown that cellulose pulp used, as heretofore, in the condition in which it is received from producers of that commodity, will not serve the purposes of this invention. For example, the individual fibres do not sufficiently take hold upon the cement/silica matrix in which they are eventually embedded. This is particularly objectionable in the case of building boards and other articles which are laminated to required thickness by the building up of a film-layer only about 0.3 to 0.5 of a millimetre thick. In this latter case the cellulose fibres not only fail to give adequate re-inforcement strength, they also fail to provide sufficient inter-lamina bond between the superimposed film-like layers.

We have found that to serve the purposes of the invention, the cellulose fibres have to be fibrillated so that the morphology of the fibres is changed. This is not to say that all the cellulose fibres in a batch thereof have to be fibrillated. Some of them may not be fibrillated at all; others may be slightly fibrillated and others much more; the necessity being, we have discovered, that in the whole mass of cellulose fibres in a batch of starting composition, the overall degree of fibrillation to prevail within the batch as a whole should reach a certain value as hereinafter set forth.

The invention provides an asbestos-free article comprising:
(a) from 6% to 12% by weight of cellulose fibres whereof at least a proportion of the individual fibres are uniformly or variously fibrillated to such a degree that the

of dry ingredients with water wherein the said composition comprises:

(a) from 6% to 12% by weight of the total composition of cellulose fibres whereof at least a proportion of the individual fibres are variously fibrillated to such a degree that the mass of said fibres, as a whole, has a freeness value of from 450 Csf to 600 Csf,

(b) from 0 to 10% by weight of a diluent such as filler and/or pigment and,

(c) the balance to 100% by weight of cement and silica in selected proportions of each to the other within the range of from 25% to 65% cement to 75% to 35% silica by weight.

It will be appreciated that almost invariably an article according hereto will consist wholly of cellulose, cement and silica. And this is correct so far as the essential basis of the invention is concerned. Even so, an article in accord with the invention may include a number of other non-essential ingredients such as colouring agents, impurities, non-essential and unimportant trace materials, extra fillers for cheapness or to provide some required property (such as easy nail-acceptability) and so on.

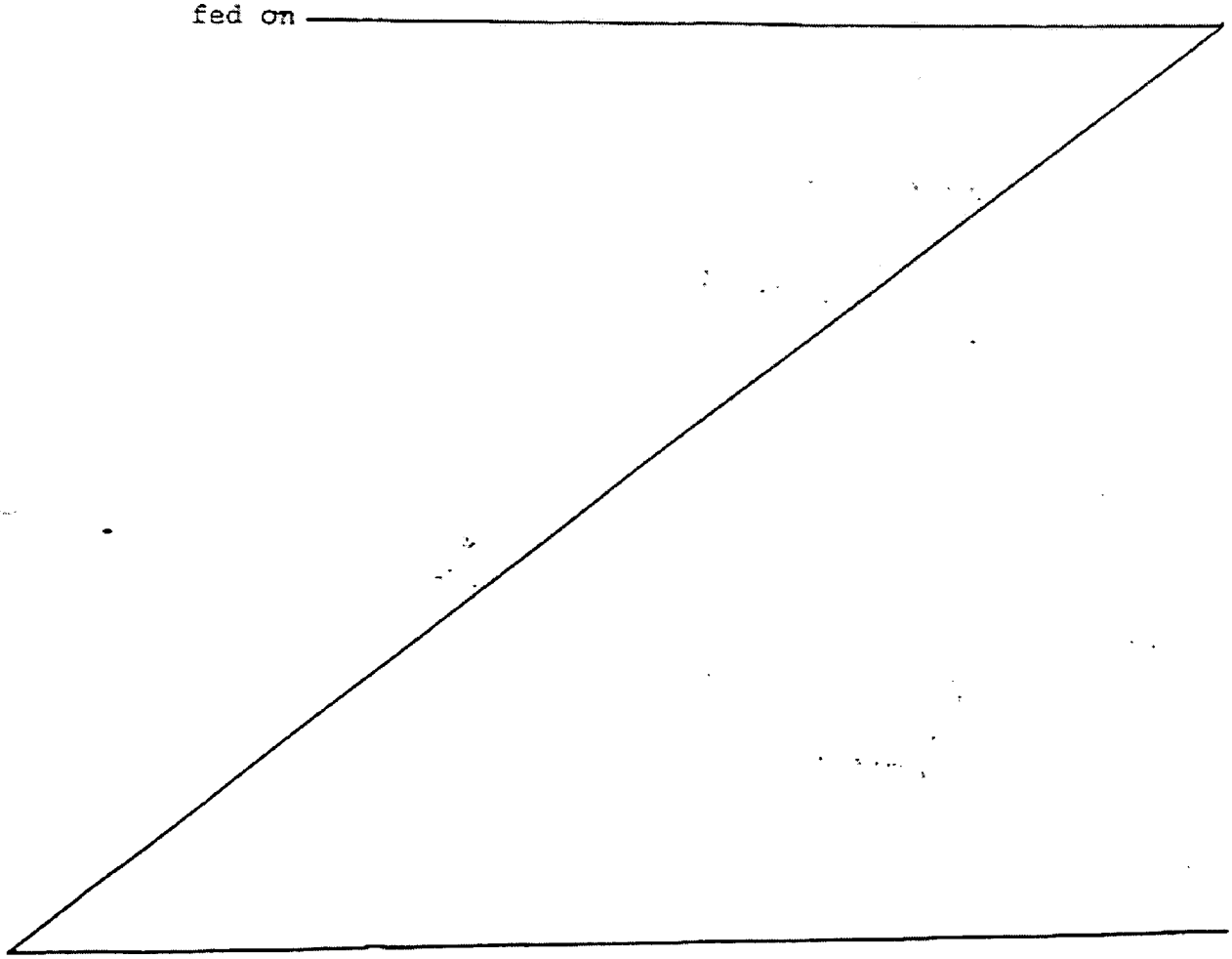
All proportions stated herein are percentages by weight.

A typical AC composition as used heretofore, for building boards is as set forth in Table A below:

TABLE A

INGREDIENT	BOARD FOR OUTDOOR USE	BOARD FOR INDOOR USE
Cellulose Pulp	7%	7%
Asbestos	8%	8%
Cement	42.5%	23.8%
Silica	41.5%	61.2%
	100.0	100.0

The ingredients of Table are commonly mixed together in the form of an aqueous slurry which is fed to a rotary filter. Most of the water is removed by the filter, and the remaining wet slurry is picked up from the filter and fed on



to a water-pervious endless conveyor belt as a film, at most, only about 0.3 to 0.5 of a millimeter thick. As this film is carried along by the belt, further water is extracted from it, and on arrival at the departure end of the conveyor it is wound onto a collector roll until the required board thickness is built up as a scroll thereon.

If flat boards are to be produced the collector roll is what is known as a size roll of which the circumference is substantially equal to the board length required. When the required thickness is reached, the scroll so formed is laterally slit and circumferentially peeled from the roll, laid out flat and autoclaved and or otherwise finished off in manner well known.

If the final article is to be in the form of a tube the collector roll is a mandrel from which the built-up scroll is slid endwise; that is, in the direction of the roll axis.

Articles whereof the composition is according hereto are produced in the same way as just described except for fibrillation of the cellulose as a pre-treatment applied thereto prior to slurry formation.

Cellulose suitable for use herein is marketed, preferably as a substantially dry wood or vegetable fibre pulp, either in compressed floc form or in lap form; the latter being in sheets similar to fairly-stiff thick paper or cardboard. The lap or floc cellulose has to be fragmented, and this may be carried out in the same way as it now is for inclusion in AC articles.

For inclusion in compositions according hereto, the fragmented cellulose has to be further treated until it

reaches a selected degree of fibrillation of the mass of cellulose fibres. This fibrillation consists in so beating, hammering or bruising the fibres that they are shredded or longitudinally split or frayed into a multiplicity of fine strands each sprouting short hair-like fibrils or tendrils which have been found to be effective in forming a good physical anchorage between the fibres and the cement/silica matrix in which they are to be included; thus giving optimum utilisation of the tensile strength of the fibres.

In practice it is found that the fibrillation step may be readily performed, as is desirable, without substantial diminution of the fibre lengths.

A preferred way of doing this is by wet slushing. This is carried out in a hydrapulper of the kind commonly used in the paper making industry. The proportion of water used in the hydrapulper is preferably such as to give a slush output consistency of about 4% of cellulose fibres disposed in water. This slush output is then fed to a cellulose refiner of the kind also used in the paper making industry.

The refiner employed is preferably of the disc type in which the slush is fed between a pair of face-to-face discs one rotating and the other stationary. The mutual spacing of these discs can be readily adjusted to an optimum clearance for the throughgoing fibres such that they are effectively fibrillated without being cut into shorter lengths.

A single refiner may be employed and, if necessary, the slush may be recycled through it the number of times required to obtain the required degree of fibrillation, alternatively, a series of refiners may be used in sequence; each (other

than the first in the series) having its pulp input as the output from the refiner ahead of it in the series.

After fibrillation the slurry may be de-watered, in known manner; where, for example, the water content of the slush exceeds the proportion required in the mentioned slurry of mixed ingredients.

To know when the required degree of fibrillation has been reached, a sample of the refiner output is taken from time-to-time and tested. After a relatively short time of initial operation the number or slush recyclings, or the number of refiners required in a series thereof, will be easily determined and only occasional testing is then required.

As far as we are aware there is no standard test for the direct measurement of the overall degree of fibrillation cellulose fibres in a batch thereof, it so happens however that the degree of fibrillation is the inverse of the "freeness" of such a batch, and therefore the testing for fibre morphology change may be easily and effectively carried out in terms of freeness.

Testing for freeness is well known and may be defined as providing an arbitrary measure of the water drainage properties of a fibrous pulp stock.

Freeness is commonly stated as a number on either of two scales known as the Csf (Canadian Standard Freeness) scale or the Schopper-Riegler scale. Either may be employed in terms of the present invention, but the Csf scale is preferred.

The Csf scale provides a measure of freeness prevailing within a mass of fibres in terms of a range of numbers

running from 0 to 800, and the number in this range due to a particular pulp sample is known as the freenessvalue of the sample, this value being expressed in terms of "Csf units".

By the present invention, the cellulose pulp is fibrillated to a degree such that its freeness value ranges between 450 Csf to 600 Csf, while an optimum value is at or towards the 450 Csf end of the stated range. If the Csf value lies outside the stated range, the objects of the invention are not sufficiently realised.

Thus, a typical composition according hereto is composed of from 6% to 12% fibrillated cellulose pulp, with cement and silica as balance at 100%, the cement : silica or silica : cement ratio being from 25:75 to 65:35.

Within the stated range the preferred proportions are as set forth in Table B.

TABLE B

INGREDIENT	BOARD FOR OUTDOOR USE	BOARD FOR INDOOR USE
Fibrillated Cellulose have a freeness value of 450 Csf	8%	8%
Cement	46%	28%
Silica	46%	64%
	100	100

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A fibre-reinforced asbestos-free cementitious article of the kind formed by mixing a composition of dry ingredients with water wherein the said composition comprises:

(a) from 6% to 12% by weight of the total composition of cellulose fibres whereof at least a proportion of the individual fibres are variously fibrillated to such a degree that the mass of said fibres, as a whole, has a freeness value of from 450 Csf to 600 Csf,

(b) from 0 to 10% by weight of a diluent such as filler and/or pigment and,

(c) the balance to 100% by weight of cement and silica in selected proportions of each to the other within the range of from 25% to 65% cement to 75% to 35% silica by weight.

2. An article according to claim 1 wherein the cellulose fibres constitute 8% of the total composition by weight.

3. An article according to claim 1 or claim 2 wherein the mass of cellulose fibres has a freeness value of 450 Csf.

4. An article according to any one of claims 1 to 3 wherein the proportions of the ingredients are:

Cellulose fibres.....8%

Cement.....46%

Silica.....46%

5. An article according to any one of claims 1 to 3 wherein the proportions of the ingredients are:

Cellulose fibres.....8%

Cement.....28%

Silica.....64%

6. An asbestos-free, fibre-reinforced article composed substantially as herein described.

DATED this 20th day of December, 1984.
JAMES HARDIE & COY. PTY. LIMITED.

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